

case than cauterization, has neither the risk nor the painfulness of that method. The principle, in all cases, is exactly the same, the substitution of an acute inflammation, with a tendency to heal, for a chronic one with a tendency to persist.

RECENT PROGRESS IN MEDICAL CHEMISTRY.

BY WILLIAM B. HILLS, M. D.

TOXICOLOGY.

Ptomaines. T. Husemann¹ gives a summary of the observations already published on this class of bodies, and considers the very important bearing they have on the study of poisons and on forensic medicine. These substances resemble the vegetable alkaloids closely in their chemical reactions and physiological effects, and it is important to discover, if possible, reactions which will distinguish between these poisonous bodies, which are the result of putrefactive processes, and those similar vegetable principles which, when administered, may produce death. "Ptomaines" seem to have different physiological actions. Some appear to act as poisons, others are inactive; whilst others counteract the effects of poisonous substances.

The study of these bodies embraces also the poisonous effects produced by food in certain conditions of putrefaction or fermentation. Panum showed that albuminous substances by putrefaction yielded a poisonous body, acting like a ferment, soluble in water, insoluble in alcohol, and capable of withstanding a temperature of 100° F. This has been confirmed by Bergmann, who describes a compound called *sepsin*, generated by putrefaction. It appears from the researches of Panum and Schweninger that compounds having different physiological actions are produced at different stages of decay.

Sonnenschein and Zuelzer found in an anatomical maceration fluid an alkaloid which resembled atropia in its action, and poisonous sausages produced a similar effect; the existence of a product of decay which caused tetanic symptoms was also noticed. Aebi and Schwazzenbach detected a compound allied to an ethereal salt in the extract from dead bodies. Substances derived from putrefaction of maize certainly produce tetanic symptoms, as was first proved by Lombroso and Erba, and this action has been traced to the presence of basic substances. Frequently the tetanizing principle in the maize extract has its action masked by a narcotic substance; just as Ranke showed that the physiological action of strychnia in bodies long buried may be masked by ptomaines.

The relation of these products of putrefaction to certain diseases is evident from the fact that Sonnenschein's alkaloid is found in the bodies of patients dying from typhus fever, and many individuals poisoned by decomposing food show marked typhus symptoms.

In many cases of poisoning by cheese it was found that the bad effect was not due to vegetable growths or to microscopic organisms, and the cheese was frequently fresh.

It appears from the study of the literature concerning ptomaines that they are usually produced in bodies which, after brief exposure, have been excluded from air, as in buried bodies, sausages, and tinned foods;

¹ Journal of the Chemical Society, London, February, 1881, page 57, from Arch. der Pharm.

and further, in these cases, the production chiefly occurs in the internal portions. Cases, however, are known where similar principles have been present in comparatively fresh substances which have been constantly exposed to the air; hence under the name "ptomaines" must be included all alkaloidal products of decay, whether formed in the presence or absence of air.

P. Spica² obtained, by Dragendorff's process, four of these bases from the liquid taken *during life* from a case of peritonitis, which had taken on a suppurative form. Their chemical reactions and physiological effects are described in the original communication. All were poisonous; three, however, only in a trifling degree. The fourth was poisonous in minute doses, and resembled curare in its physiological effects.

Jansen³ has described at length the chemical and physical properties of ptomaines. The original article, which is of interest to toxicologists especially, must be consulted by those who desire information concerning this part of the subject. According to Jansen, the symptoms produced by poisonous ptomaines are the following: immediate contraction, rapidly followed by dilatation of the pupil, immediate diminution and irregularity of the heart-beat, convulsive movements.

Brouardel and Boutmy⁴ have detected several of these ptomaines; in one case in the organs of a person who had died from the effects of carbonic oxide; in a second case in the organs of a person who had died from the effects of white arsenic. This latter alkaloid had been previously detected twice by Selmi under similar conditions. According to the authors, each case of putrefaction does not give rise to a distinct ptomaine. For example, they found the same ptomaine in the organs of two persons, one of whom died from carbonic oxide, the other from prussic-acid poisoning. Brouardel and Boutmy met with an alkaloid resembling veratria in a body which had lain eighteen months in the Seine, and another in a goose which had been subjected to the heat necessary to cook it. They consider many of these ptomaines poisonous to man, and ascribe to them the poisonous effects which are sometimes produced by food of various kinds. They mention a case in which twelve persons were attacked with all the symptoms of acute poisoning after eating a tainted goose, which was found upon analysis to contain a liquid ptomaine analogous to codeia; of these twelve persons one died after some hours. The symptoms were nausea and repeated vomiting.

Ptomaines presenting in general the more important chemical and physical properties of the vegetable alkaloids may readily be confounded with the latter. The proper method of distinguishing the two consists in determining *all* the chemical and physical properties of the toxic base isolated and comparing them with those of the vegetable alkaloid whose presence is suggested. This method can, however, be employed only in cases where the quantity of the poison isolated is tolerably large. Brouardel and Boutmy⁵ have endeavored to find a reagent which is sufficient in all cases to disclose the character of the alkaloid extracted, and think they have discovered such a reagent in potassium ferricyanide. If the latter is instantly

² Ber. d. deutsch. chem. Gesellsch., xiv. p. 274, from Gazz. Chim.

³ Journal de Pharm. et de Chimie, January, 1881, page 44, from Pharmaceutische Zeitschr. für Russland.

⁴ Journal de Pharm. et de Chimie, November, 1880, page 392.

⁵ Compt. Rend., xcii. p. 1056.

changed to potassium ferrocyanide (determined by neutral ferric chloride), and at the same time the base is precipitated by iodo-mercurate of potassium, the base in question is a ptomaine; if the ferricyanide is unchanged and the substance behaves with the iodo-mercurate of potassium as do the vegetable alkaloids, the base is a vegetable alkaloid. In applying the test the base is converted to a sulphate, and a few drops of the solution of this salt are placed in a watch-glass containing a little ferricyanide in solution; a drop of neutral ferric chloride is then added. According to the authors, morphia and veratria, of the vegetable alkaloids, are the only exception to the above.

Ch. Tanret¹ has repeated the experiments of Brouardel and Boutmy, and although he finds that ptomaines produce the change above described, they do so only slowly. He also finds that a similar slow change is produced by crystalline ergotinine and aconitine, and by amorphous and crystalline digitaline; while the change is produced instantaneously by morphia, eserine, liquid hyo-cyama, and amorphous aconitine and ergotinine. Great caution should therefore be taken in employing the test, the more so as the list of vegetable alkaloids is probably far from complete.

Arsenic. A case of poisoning having occurred in which food containing arsenious sulphide was suspected, Ossikowszky² was led to make experiments to determine whether it is possible that, during the process of putrefaction of organic bodies, arsenious sulphide may be converted into oxide. It is generally supposed that pure arsenious sulphide, however prepared, has no poisonous action on the living organism. The author therefore considers that in the case in question the arsenious oxide must have been present as an original impurity (as is sometimes the case), or as a product by chemical change of the sulphide.

Experiments were made by exposing a mixture of arsenious sulphide, water, and pieces of decomposing pancreas to a temperature of 35 to 40° F. for a period of seven days. Samples for analysis were removed at intervals and filtered; the filtrate, on being acidified, yielded a precipitate of arsenious sulphide, and the acid filtrate was tested for arsenious and arsenic acids. It was found that precipitated arsenious sulphide was much more rapidly oxidized under these circumstances than the more compact crystalline orpiment, but the result obtained from both kinds of sulphide was similar. The albuminoid bodies present, on decomposition, yielded ammonia, which dissolved a portion of the sulphide as such; this was precipitated on acidifying the liquid with hydrochloric acid; the arsenious sulphide was also oxidized to arsenious acid and to a smaller extent to arsenic acid; the quantities of these oxidation products formed increasing in proportion to the time.

Further experiments proved that in the absence of the pancreas the presence of water at a moderate heat was sufficient to convert the precipitated arsenious sulphide into arsenious but not into arsenic acid. The author further tried the effect of making the liquid in which the arsenious sulphide and decomposing organic matter were present alkaline with sodium carbonate, so as to imitate the conditions existing in the large intestine where alkaline secretions would mingle with the food. It was found that the quantity of oxidized

arsenic compounds formed was quite sufficient to produce poisoning.

F. Selmi³ is undertaking experiments to ascertain in what state arsenic occurs in the urine of subjects poisoned with this substance. Arsenic was administered to a large dog in doses too small to produce fatal effects, and the urine examined over a considerable period. It was found that during the first period of three days the urine contained an acid of arsenic, precipitable by baryta, and another arsenical compound which was not precipitated by baryta; the same substances were found in the second period of five days, besides a volatile arsenical compound which gave a crystalline hydrochloride; subsequent to this the arsenical base gradually disappeared.

According to E. Reichardt⁴ it is unnecessary, in testing the urine for arsenic in cases of chronic arsenical poisoning, to destroy the organic matter. The urine (one or two liters), acidified and gently heated, may without further treatment be saturated with hydrogen sulphide. It is then allowed to stand, covered, for twenty-four hours, after which it is filtered, and the precipitate examined for arsenic by appropriate methods. The same is true in case lead, bismuth, copper, antimony, or mercury are to be sought for.

Ch. Brame⁵ employs baryta instead of potassium cyanide or black flux for the reduction of arsenious acid. The reaction manifested by the mixture of arsenious acid and baryta heated to redness is instantaneous, and is not accompanied by any disengagement of moisture. The ring formed has a perfect metallic appearance. There is formed, besides metallic arsenic, barium arseniate, which may be dissolved in nitric acid and tested with silver nitrate. Analogous but less marked results are obtained with lime, potassa, and soda. Arsenic sulphides also yield metallic arsenic with baryta, though less easily than arsenious acid does. In the case of orpiment there is deflagration.

Investigations on the localization of arsenic in cases of poisoning have been previously noticed.⁶ E. Ludwig⁷ has further studied this question, and gives the following *résumé* of the results obtained by him from experiments made upon animals as well as from cases of poisoning in man:—

In cases of acute as well as chronic arsenical poisoning arsenic is taken up by the bones in small yet distinctly recognizable quantities. If the case is non-fatal arsenic may be found in the bones a long time after the last administration. In one case arsenic was found in the bones on the twenty-seventh day after the last dose; in one case, examined forty days after the last administration of the poison, the bones contained none. It is worthy of note that the liver in both these cases still contained arsenic.

In the brain, in cases of poisoning, both acute and chronic, only a small amount of arsenic is to be found, while the liver and kidneys contain a comparatively large quantity.

The kidneys in acute cases may contain a larger proportion of arsenic than the liver. The muscular tissue contains only a small quantity, but always more than the brain.

Arsenic is found in the liver for a longer period than

³ Journal of the Chemical Society, London, May, 1881, page 311, from Gazz. Chim., x. 431.

⁴ Archiv der Pharm., October, 1880, page 291.

⁵ Compt. Rend., xcii. p. 188.

⁶ Vide this Journal, February 5, 1880, page 129.

⁷ Chemisches Centralblatt, 1881, pages 90, 110, 121.

¹ Compt. Rend., xcii. p. 1163.

² Journal of the Chemical Society, London, March, 1881, page 123, from J. pr. Chem.

in any other organ. Ludwig's paper is a long one, and contains in full the results of his investigations.

Ludwig's conclusions are confirmed, in a case of poisoning from Paris green, reported by Bergeron, Delens, and L'Hôte,¹ who found seven times as much arsenic in the liver as in the brain. The kidneys and muscular tissue also contained more than the brain.

S. W. Johnson and R. H. Chittenden,² in a case of arsenical poisoning reported by them, also found the amount of arsenic in the brain to be less than in any other organ.

In another case reported by Johnson, — a case of acute poisoning, — 83.23 grains of arsenious oxide were found in the stomach, liver, and other internal organs, while the brain contained a hardly perceptible trace of arsenic.

Johnson and Chittenden also report the results of an experiment conducted on a large dog, to which was given 6.5 grammes solid arsenious oxide, mixed with meat, during a period of eight days, in doses increasing from 0.1 gramme to 2.5 grammes per day. The dog was killed twenty-four hours after the last dose. The intestines, liver, kidneys, muscular tissue, urine, brain, and blood were examined. Of all these the brain contained the least arsenic.

It appears, therefore, from the cases which have been reported, that the amount of arsenic absorbed by the brain is very small compared with the amount absorbed by the other organs and tissues.

R. H. Chittenden and H. H. Donaldson³ have contributed an article On the Detection and Determination of Arsenic in Organic Matters, which is of interest to toxicologists, but unsuitable for a detailed notice here. The process which they recommend for the destruction of organic matter is Gautier's,⁴ somewhat modified; and for the quantitative testing of arsenic they recommend the decomposition of arseniuretted hydrogen by heat. They describe a form of Marsh's apparatus so modified as to furnish a slow and even evolution of gas, so that all loss may be avoided; and to still further prevent loss they employ the process recently described by Gautier,⁵ in which he controls the evolution of gas by slowly introducing the arsenic mixed with a definite quantity of dilute sulphuric acid of known strength, later adding the same quantity of a stronger acid, and lastly a still stronger acid; the increasing strength of acid added counteracting the diluting effect of the reaction, so that the strength of the acid remains about the same during the entire process of two and one half to three hours. The strength of the acids employed is given. They decompose the gas by passing it through a tube heated for a distance of six inches. Under these circumstances no trace of arsenic passes by. The arsenic is weighed as metallic arsenic. The whole method is recommended as being accurate, delicate, and requiring the use of but three chemicals, — sulphuric acid, nitric acid, and zinc.

The authors state that, contrary to the prevailing opinion, the presence of organic matter, even in considerable quantity, does not interfere with the detection and determination of arsenic by Marsh's test. Frothing, due to organic matter, may be prevented by

introducing fifteen drops of sweet oil, which floats on top. The only other things to be guarded against are, first, the too rapid introduction of the acids, whereby loss as well as frothing of the mixture may ensue; and secondly, the heating of the flask by the chemical reaction. The latter may be prevented by keeping the flask surrounded by cold water. The paper contains the results of numerous experiments.

(To be concluded.)

Hospital Practice and Clinical Memoranda.

THREE CASES OF UNILATERAL CEREBRAL HYPERÆMIA.

BY GEORGE JEWETT, M. D., FITCHBURG.

CASE I. The subject of this history is a stout, robust woman of thirty-six years, and at the time of the attack of which I am about to speak was the mother of four children. She has borne one since. All are remarkably well and strong.

December 18, 1875, Mrs. D. was busily sewing near a furnace register, and did not notice the continued increase of heat until she observed herself in a profuse perspiration. She was dizzy, her head was hot, and felt badly. These sensations but partially left her during the following night and day. The second night, while in the act of lying down, she suddenly became violently dizzy and unconscious. Consciousness returning, she began to vomit. Passing an unknown time in vertigo and nausea, she finally observed that when lying on the right side all her distress quickly left her, and she soon felt in her usual health. It, however, instantly returned when she rotated her head to the left of the median line or lay flat upon her back. She could nurse her babe, then about a month old, only when lying well on her right side, and partly on her face and chest. She slept but little during the night, and I was called the next morning. She was sitting up; her face was flushed, apparently from mental anxiety, and she was a good deal frightened on account of the anomalous symptoms from which she suffered. The pulse was a little quickened, temperature and respiration normal; she had some appetite, and the bowels were regular. There was no disturbance of tactile sense nor paresis. She stated she was comfortable every way provided she kept her head well to the right and forward of the vertical line, and was able to attend to her ordinary family duties provided they did not interfere with the prescribed position of her head. She could not, however, lie flat upon her back without an instant return of the vertigo and nausea. She continued in this condition, with only a slight amelioration of symptoms, for about two months. When in the act of sportively tossing her baby, she lost consciousness, dropped her child, and fell. There was no epileptic cry or convulsions, and return of consciousness was immediate and complete. She now observed she could not drain a drinking cup, as the tipping the head backward immediately brought a return of the dreaded vertigo and nausea. Sometimes on rising from a stooping position she would stagger backward, unable to recover herself until arrested by the wall of her room.

On lying down, she often experienced a sensation in

¹ Annales d'Hygiène.

² American Chemical Journal, ii. p. 332.

³ American Chemical Journal, ii., No. 4.

⁴ Vide this Journal, January 13, 1876, page 39.

⁵ Bull. de la Soc. Chim., xxiv. p. 258.